Complications in Endoscopic Procedures 17.2

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17.2.1 Complications of Percutaneous Nephrolithotomy

17.2.1.1 Intraoperative and Early Postoperative Complications

The first nephroscope for percutaneous renal access was introduced 1981 by Marberger et al. (1981, 1982). Since that time, percutaneous nephrolithotomy (PCNL) has evolved as a standard procedure in kidney stone therapy. In this chapter, we will focus on the complications of this procedure.

Infection and Sepsis

Infection and sepsis are very rare complications in PCNL, occurring in up to 2.2% (Lewis and Patel 2004). As in all other invasive stone procedures, preexisting urinary tract infection is treated at least 2 days in advance. Cases of obstruction and infection should primarily be managed by percutaneous drainage. PCNL is delayed until the infection has been treated successfully (urinary culture, hematologic signs of recovery from sepsis). During PCNL, we recommend prophylactic antibiotics in all cases. Antibiotic agents are selected according to local bacteria strain spectrum and resistance patterns, which should be monitored on a regular basis. At our institution, we commonly use fourth-generation chinolones, amoxicillin plus clavulanic acid, or an aminoglycoside.

Care must be taken to avoid high-pressure irrigation during the procedure, as this can lead to bacteriemia and subsequent sepsis. To avoid high-pressure irrigation, we use a continuous flow nephroscope. The irrigation container must not be mounted higher than 40 cm above kidney level (Kukreja et al. 2002; Troxel and Low 2002).

Complications with the Percutaneous Nephrostomy Tract

The most severe complication of PCNL is puncturing other organs, especially colon, pleura, liver, gallbladder, or spleen. If the injury is recognized during the procedure, the complication can usually be handled straightforwardly. Unfortunately, most of these complications are diagnosed with a delay of several hours or even days.

Injury of the Colon

Routine preoperative ultrasound shows the anatomical relation of the colon and the kidney and is an important tool to prevent injury. Previous intraabdominal or renal surgery is associated with a higher risk of injury of the colon and may warrant preoperative CT of the abdomen to define anatomic relations.

Fig. 17.2.1. Perforation of the left colon during PCNL. Note extravasation of contrast medium from renal collecting system into the descending colon

Needle perforation of the colon is usually not recognized. Colonic perforation with the nephroscope is recognized after contrast filling of bowel at the nephrostogram at the end of the procedure (Fig. 17.2.1). Furthermore, bowel perforation must be suspected in all patients with abdominal pain postoperatively. The anatomic compartment of perforation – retroperitoneal or intraperitoneal – is differentiated by CT scan (distribution of air, fluid; Figs. 17.2.2 – 17.2.4). A water soluble contrast enema study can also be a valuable diagnostic tool.

Needle perforation is usually managed conservatively by observation of the patient. In case of a retroperitoneal perforation of the colon, placement of a nephrostomy tube should be avoided, and the collecting system of the kidney may be drained by a double-J stent. Intraabdominal perforation of the colon requires surgical intervention in almost all cases – usually a transient colostomy (Vallancien et al. 1985).

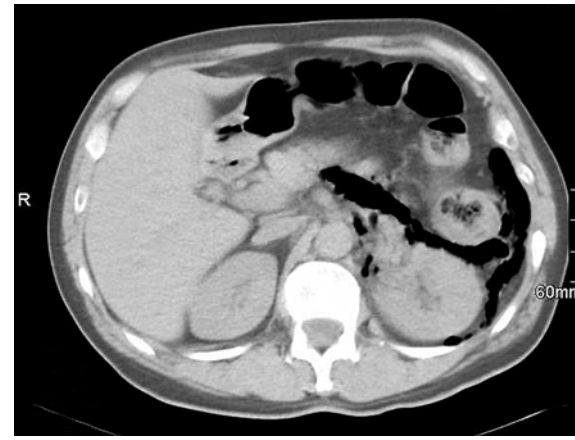

Fig. 17.2.2. Abdominal CT: retroperitoneal air after perforation of the left colon during PCNL

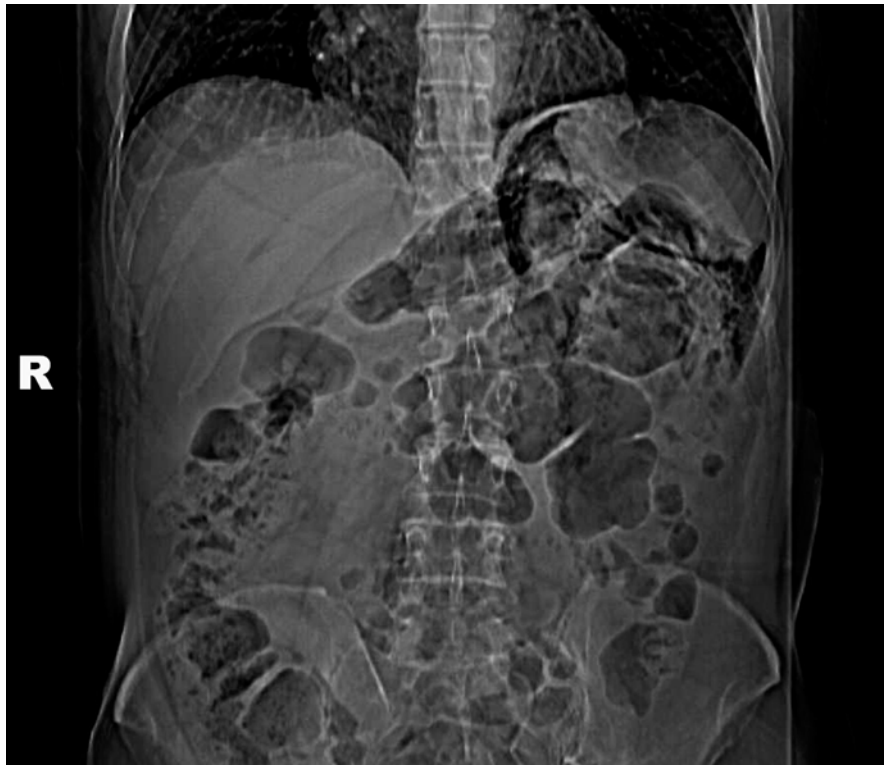

Fig. 17.2.3. Plain abdominal film: retroperitoneal/subphrenic air after perforation of the left colon during PCNL

Fig. 17.2.4. MRI of the abdomen (coronal section/reconstruction): Fistula between kidney and left colon and puncture canal in the lower pole of the kidney (*arrow*)

Injury of the Pleura

Injury of the pleura with consecutive pneumo-, fluido-, or hemato-thorax occurs in 0.87 % of patients (Lallas et al. 2004). Any dyspnea or thoracic pain must be suspected for puncture of the pleura. Immediate chest x-ray is mandatory in this case. Injury of the pleura can effectively be avoided by puncture below the 12th rib (Munver et al. 2001). Access above the 11th rib significantly increases the risk of pleura injury (Golijanin et al. 1998).

Lesions of the pleura are usually managed conservatively; chest tube drainage can be necessary depending on the extent of pneumo- of hemato-/fluido-thorax.

Injury of the Liver, Gallbladder, or Spleen

Injury of the liver, gallbladder, or spleen are very rare. They are usually not recognized intraoperatively. Bleeding from parenchymatous organ injury can cause hemodynamic problems and abdominal pain. Therapy should follow the same principles as in trauma to these organs. In rare cases of intraoperative recognition of organ injury – usually due to hemodynamic instability – the procedure is terminated and the organ injury managed according to surgical principles.

Bleeding

Bleeding is the most common complication in PCNL, occurring in 0.6 % – 2.3 % (Lewis and Patel 2004; Gremmo et al. 1999). Factors increasing the risk of blood loss have been shown to be diabetes mellitus, multiple-tract procedures, prolonged operative time, and the occurrence of intraoperative complications (Kukreja et al. 2004). Every form of bleeding during or after the procedure requires careful monitoring of hemodynamic and laboratory parameters (red blood count, blood pressure).

The source of bleeding can be renal parenchymal or direct vessel injury. Intraoperative bleeding can make termination and staging of the procedure necessary. Venous bleeding usually stops with plugging the nephrostomy tube leading to tamponade. In contrast to other experts, we recommend insertion of a nephrostomy tube not greater than 14 F. The smaller tube allows for better tissue contraction along the nephrostomy tract. Bleeding from the nephrostomy tract at skin level is managed by a tobacco-pouch suture around the tube. If arterial bleeding causes hemodynamic instability in the patient or a drop in red blood cell count requiring transfusions, angiography and embolization is necessary (Kessaris et al. 1995; Martin et al. 2000). If unsuccessful, open surgery is recommended. However, this situation is exceedingly rare – with a reported rate of 0.1 % in one large series (Kessaris et al. 1995).

Perforation of the Renal Pelvis

Perforation of the renal pelvis occurs frequently during PCNL. Intraoperatively, it can lead to increased bleeding and reduced irrigation pressure with impaired visualization. Usually a nephrostomy tube drainage is sufficient to handle this event. In our department, we perform a nephrostogram at the end of the procedure to localize a possible extravasation. An additional nephrostogram is then performed on the second postoperative day to document resolution.

Additional double-J stenting may be necessary to bypass edema of the ureteropelvic junction mucosa or residual stones. Parsons et al. reported infundibular stenosis after PCNL in five of 223 patients treated (2 %) as a late sequela of renal pelvis injury in cases with prolonged operating time and large stone burden (Parsons et al. 2002).

Residual Stones

Residual stones after PCNL can be managed by an additional percutaneous procedure or by ESWL.

Absorption of Irrigation Fluid

Problems of irrigation fluid absorption only arise if electrolyte-free solution is used with high pressure and open vessels or renal pelvis perforation. This can lead to water intoxication – also known as TUR syndrome – with hyponatremia and hyposmolarity. It can be prevented by the use of saline and low-pressure irrigation (Schultz et al. 1983). We have never seen problems related to irrigation fluid temperature, even in longer procedures of up to 4 h.

Nephrostomy Tubes

In uneventful cases of PCNL, nephrostomy drainage is not always indicated (Shah et al. 2005). Our indications for a nephrostomy tube drainage are bleeding, extravasation of contrast medium at the end of the procedure, residual stones, obstruction, and infection. Dislocation of a nephrostomy tube must be handled according to symptoms.

17.2.1.2 Late Postoperative Complications

Renal Function Impairment

Renal damage following PCNL usually is insignificant (Chandhoke et al. 1992). An early follow-up study showed no renal function deterioration on split ^{131}I-Hippuran clearance studies 1 year following PCNL in 18 patients (Marberger et al. 1985).

Urinomas

Small – asymptomatic – urinomas are absorbed without late sequelae. Larger and symptomatic urinomas require ultrasound- or CT-guided drainage (Titton et al. 2003). In general, postoperative urinomas are treated in the same way as traumatic urinomas.

17.2.2 Complications of Ureterorenoscopy

Since Pérez-Castro Ellendt and Martínez-Piñeiro introduced the first rigid ureteroscope for endoscopy of the entire ureter including the renal pelvis, ureterorenoscopy has evolved to an indispensable instrument in endourologic surgery. With advanced instruments and experience, safety of the procedure has steadily increased over the last 25 years (Johnson and Pearle 2004).

17.2.2.1 Intraoperative and Early Postoperative Complications

Infection, Sepsis

Postoperative fever higher than 38 °C occurred in 22 % in one large series of 1,575 patients without routine perioperative antibiotic prophylaxis; however, the postoperative infection rate was only 3.7 % (Jeromin and Sosnowski 1998). Sepsis is very rare following URS, with a reported rate of 0.3 % – 2 % (Schuster et al. 2001; Stoller and Wolf 1992). Every effort should be made to avoid retrograde URS in patients with bacteriuria or hematologic signs of infection. In patients with fever and obstruction, a percutaneous nephrostomy drainage or double-J stenting are mandatory.

Avulsion and Intussusception of the Ureter

The most severe complication of ureterorenoscopy is avulsion of the ureter. This usually happens with trapping the ureteral mucosa with a basket (Fig. 17.2.5). Fortunately, avulsion is an extremely rare complication, occurring in 0.0 % – 0.3 % according to three large reviews (Stoller and Wolf 1996; Grasso 2001; Alapont Alacreu et al. 2003). It is usually recognized immediately. Avulsion of the distal ureter is handled by ureteroneocystostomy (psoas hitch, Boari flap). Lesions of the upper ureter require replacement of the ureter by bowel or alternatively autotransplantation (Maier 2002). To prevent ureteral avulsion, baskets should only be used under vision in the lower ureter (Johnson and Pearle 2004). In rare cases of small stones in a dilated ureter, basketing is possible only under direct vision.

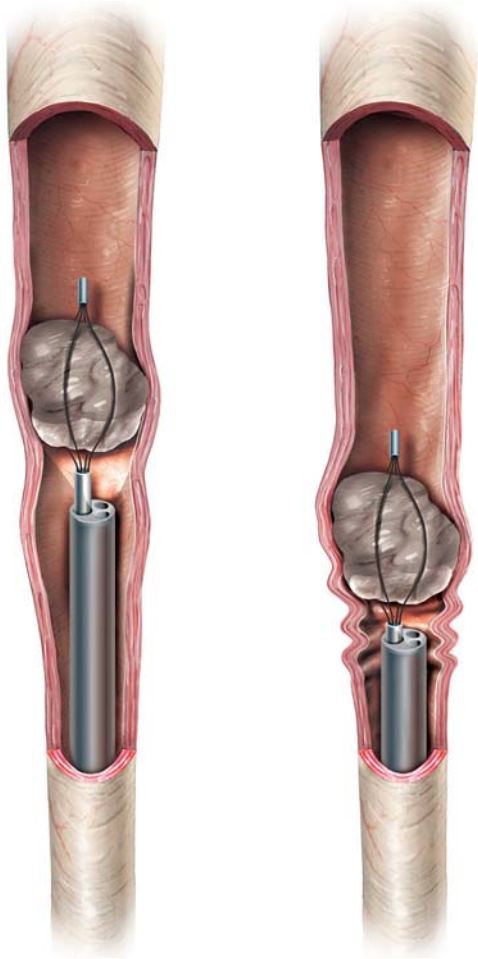

Fig. 17.2.5. Mechanism of avulsion of the ureter with basketed stone during URS (© Hohenfellner 2007)

Entrapment of a stone in the basket can create a major challenge. In this case, we recommend release of wire and basket and bypassing the wire with the ureteroscope to disintegrate the stone. This should be done with an ultrasound probe or a laser device.

Intussusception of the ureter – the invagination of a mucosal sleeve – is a very rare complication of URS (Bernhard and Reddy 1996). The mechanism is the same as in avulsion (Fig. 17.2.6). It is usually managed by open or laparoscopic reconstruction.

Fig. 17.2.6. Intussesception (and avulsion) of the distal ureter through the ureteral orifice into the bladder

Injury of Neighboring Organs

Injury to other organs is extremely rare. In their series of 4,645 consecutive ureterorenoscopic procedures, Alapont Alacreu and colleagues reported ureteroiliac fistulae in 0.02 % (Alapont Alacreu et al. 2003). Management of organ injury has to be individualized based on the same principles as mentioned previously for complications of PCNL.

Ureteric Perforation

Perforation of the ureter during ureterorenoscopy occurs in 1.2 % – 6.1 % according to recent reviews (Fig. 17.2.7) (Alapont Alacreu et al. 2003; Stoller and Wolf 1996). Perforation rate is influenced by instrument diameter and has steadily decreased over time (Johnson and Pearle 2004). Ureteral perforation is usually managed by placement of a double-J stent for 2 – 3 weeks. If stent placement is not possible, a percutaneous nephrostomy drainage is the therapy of choice. Open surgery is rarely indicated (Jeromin and Sosnowski 1998)

False Passage

False passage – perforation of ureteral mucosa only – occurs in up to 0.9 % of ureterorenoscopic procedures (Blute et al. 1988; Grasso 2000). It usually happens during passage of a guidewire and can remain unrecognized. If encountered, it is usually negotiated under direct vision and the ureter is stented at the end of the procedure.

Bleeding

Bleeding during ureterorenoscopy is usually associated with stone disintegration procedures. Its major consequence is impaired vision during the procedure. Major bleeding during ureterorenoscopy is extremely rare. Minor bleeding occurred in 0.3 % – 2.1 % in three large series (Blute et al. 1988; Abdel-Razzak and Bagley 1992; Grasso 2000). Bleeding can require termination of the procedure. It is usually managed by double-J stenting.

Narrowing of the Ureter and Difficult Access

Obstructed segments of ureter can complicate ureterorenoscopy and may require dilation or double-J stenting for at least 48 h. Stenting relaxes and dilates the ureter, facilitating second-stage ureterorenoscopy. The proximal ureter is often more easily accessed via an antegrade percutaneous route (Schmidt 1990).

Difficult ureterorenoscopic access can be expected in patients with previous retroperitoneal or peritoneal surgery with consecutive fixation of the ureter. Flexible ureterorenoscopy can solve this problem.

Residual Stones

Residual stones after ureterorenoscopic stone surgery are rare because of sufficient irrigation and postoperative ureteral stenting in case of small residual fragments. Ureterorenoscopic stone treatment of renal stones constitutes a higher risk for residual ureteric fragments or even steinstrasse (Rudnik et al. 1999). They are usually managed by ESWL or repeat URS depending on size and location. In case of steinstrasse, ESWL of the leading fragment may be sufficient (Kim et al. 1991).

17.2.2.2 Late Postoperative Complications

Ureteric Stricture

Following ureterorenoscopic stone surgery, strictures occur in 0.0 % – 4.0 % (Stackl and Marberger 1986; Beaster 1986). Ureterorenoscopic treatment of upper tract transitional cell carcinoma is associated with a higher stricture rate, ranging from 0 % to 16.2 % (Elliott et al. 1996, 2001; Martinez-Pinero et al. 1996; Chen and Bagley 2000). Stricture formation should be prevented by minimizing ureteral injury and postoperative stenting in case of perforation of the ureter (Stoller et al. 1992).

Fig. 17.2.7. Perforation of left ureter with contrast extravasation and management with double-J stent placement

Forgotten Ureteric Stent

A forgotten ureteric stent is a rare but possibly serious complication following urologic procedures. In a series of 31 forgotten indwelling ureteral stents by Monga et al., 68 % were calcified and 14 % were calcified and fragmented (Monga et al. 1995). Half of the patients could be managed by ureteroscopic stent extraction alone; one-third required additional ESWL. The remainder needed either percutaneous nephroscopy, cystoscopic electrohydraulic lithotripsy, open cystolitholapaxy, or simple nephrectomy. To prevent stents from being forgotten, meticulous patient information and close active follow-up are mandatory.

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